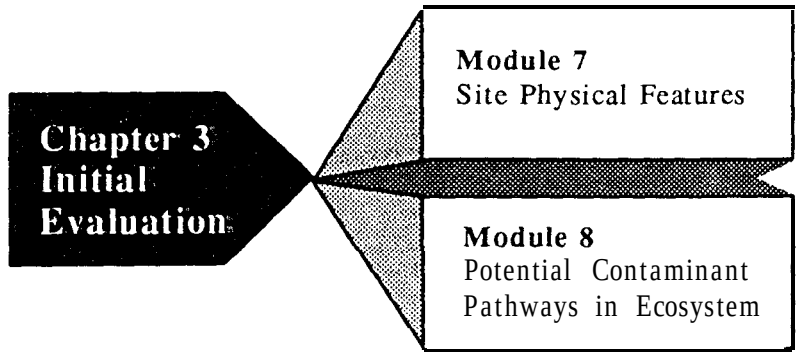
CHAPTER 3

Initial Evaluation



CONTENTS

CHAPTER 3: INITIAL EVALUATION

The ecological work plan should include a section describing important site physical features, which aids in understanding the potential for transport of contaminants both on- and off-site. Groundwater and surface water pathways are important considerations in planning tasks to determine the ecological effects of contaminants. The movement of a contaminant from a location in or adjacent to a surface water body is important information in planning sampling of such groups as benthic invertebrates or of fish habitats. Locations of contaminants with respect to topographic features such as slopes, ridges, or depressions are important at sites having surface contamination. Topographic features provide insight on the potential extent of contamination by hazardous substances from a point source.

The ecological work plan should only contain information on physical features relevant to ecological data collection and analytical tasks described later in the work plan. More detailed information on the physical features of the site would be included in the overall RI/FS work plan.

Understanding potential contaminant pathways to ecological receptors requires a thorough understanding of air, water (surface and groundwater), sediments, and soil transport mechanisms. Information obtained in scoping (see Module 5) should assist the DOE ERPM in determining the need for additional ecological field studies to better define potential pathways. For example, members of the public may know of existing areas of contamination or areas believed to be contaminated relative to recreationally important species or sensitive plant communities. This input could serve as guidance for initial off-site sampling locations.

As part of the initial evaluation project ecologists should become familiar with recent literature on ecological risk assessment (Bar-tell et al. 1992; Maughan 1993; Suter 1993). Two themes are found in these documents relative to conducting acceptable ecological risk assessments. First, the ecological **team** must properly define the ecological endpoints, realizing the normal variation in the ecosystem, based on a thorough site characterization early in the risk assessment process. The second theme centers on the need for model use in estimating exposure assessment and contaminant transfer within the ecosystem. This concept often requires a phased approach to field sampling and toxicity testing.

In addition to the above considerations, project ecologists must develop a good understanding of existing ecosystems to address such issues as natural variability at the CERCLA site and/or reference site and appropriate statistical tests for the species being analyzed. For example, plant communities consisting of a few species, such as a short grass prairie or agricultural **system,** may vary little when sampling for primary production or species diversity; whereas sampling of deciduous forest plant communities undergoing secondary succession may result in highly variable data, depending on location and time of sampling. Understanding normal seasonal variation and within-season variation is important in structuring sampling design.

References

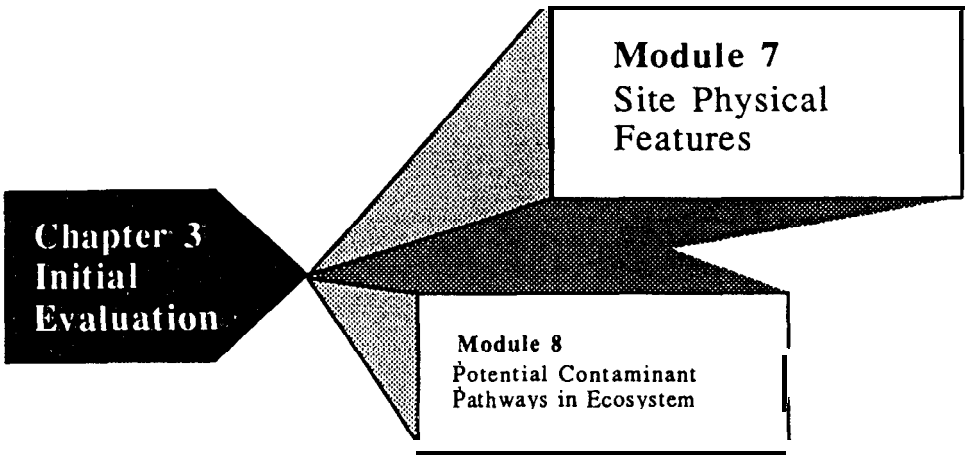
Bartell, S.M., et al. (eds.), 1992. ***Ecological Risk Estimation.*** Lewis Publishers, Chelsea, Mich.

Maughan, J.T., 1993. ***Ecological Assessment of Hazardous Waste Sites.*** Van Nostrand Reinhold, New York.

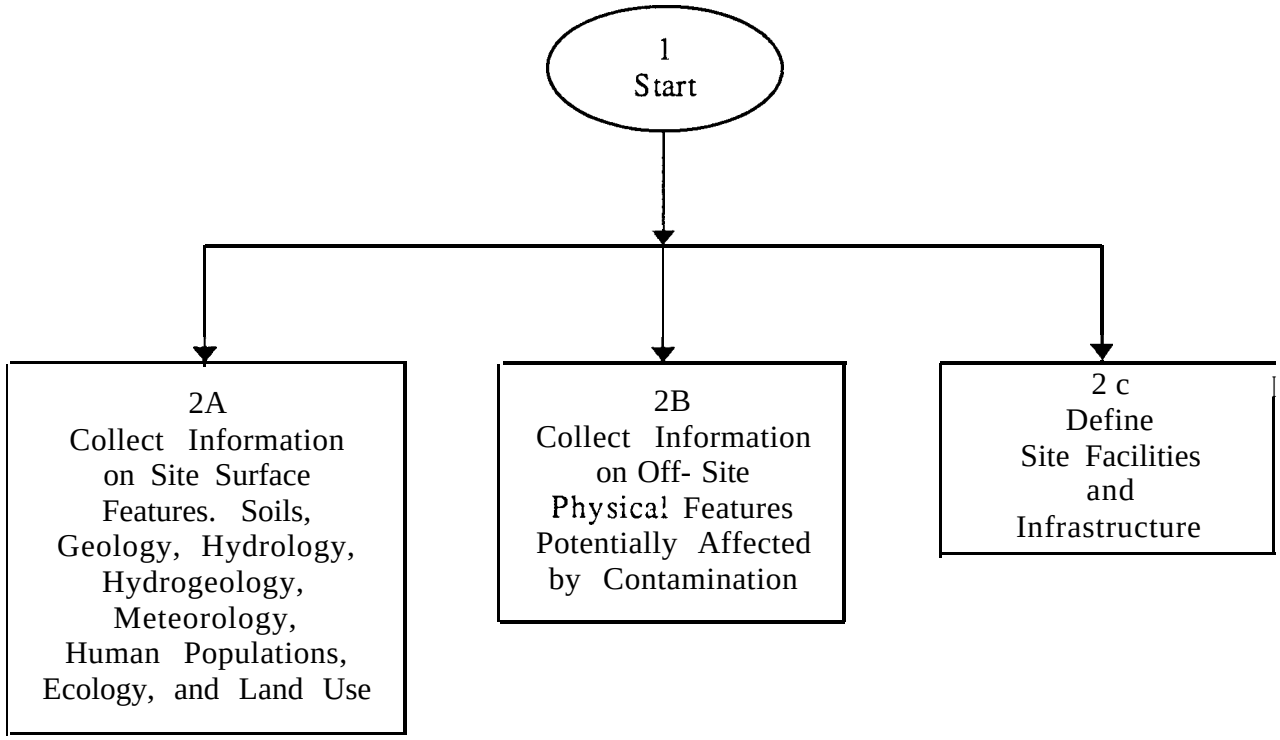
Suter, G.W., II, 1993. ***Ecological Risk Assessment.*** Lewis Publishers, Chelsea, Mich.

MODULE 7:

SITE PHYSICAL FEATURES



Module 7: Site Physical Features



MODULE 7: SITE PHYSICAL FEATURES

Step 1 Start.

Step 2a, 2b Developing an accurate description of site physical features (i.e., topography, geographic setting, locations of streams and surface waters, depth to groundwater, and spatial distribution of ecological communities), and facilities/ infrastructure is paramount to setting the baseline for conducting a risk assessment. Guidance on conducting remedial investigations at CERCLA sites (EPA 1988a) should be reviewed by all technical specialists involved in site characterization planning. This review would inform the project ecologist of the overall RI/FS process and provide an overview of where in the process ecological input is needed. Activities in Steps 2a, 2b, and 2c should be conducted in parallel. Both on- and off-site physical features currently or potentially affected by the unremediated CERCLA site, or that may be affected by remediation, require accurate definition **(see Appendix A, Sections k1.2 and A.1.3).**

Step 2c Existing site facilities (including waste impoundments, landfills, and historic facility locations) and their contribution to site contamination require careful delineation during site characterization (see **Appendix A, Section A.1.1)**. Full descriptions of existing utility and transportation systems must be developed and provided to the decision maker responsible for logistical aspects of remedial alternatives development.

Waste impoundments and landfills from past research or production activities and abandoned facilities often contribute to soil, surface water, and groundwater contamination. Habitats and biota in and around these areas should be carefully analyzed to determine (1) current contamination levels in the abiotic and biotic components of the site ecosystems, and (2) the potential for biomagnification within the food chain if the site were to continue in an unremediated condition. Careful attention should be given to defining contaminant types and their distribution. Improper definition of contaminants can result in costly, inappropriate analyses of biotic samples.

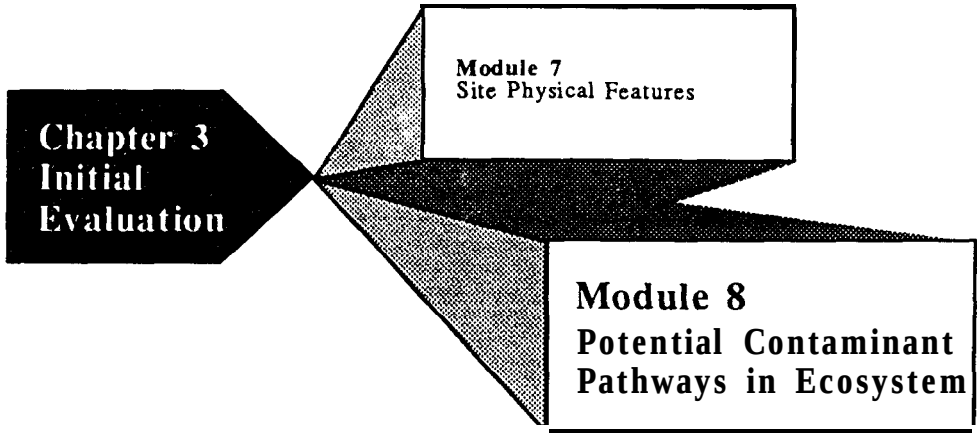
The locations, types, and conditions of existing roads are important considerations in planning the logistics of transporting contaminants from the site. This information will be useful in determining the extent to which roads and bridges will need to be upgraded in order to carry out the remedial actions. The need for road upgrades or siting of new off-site roads to conduct remediation should also be determined.

References

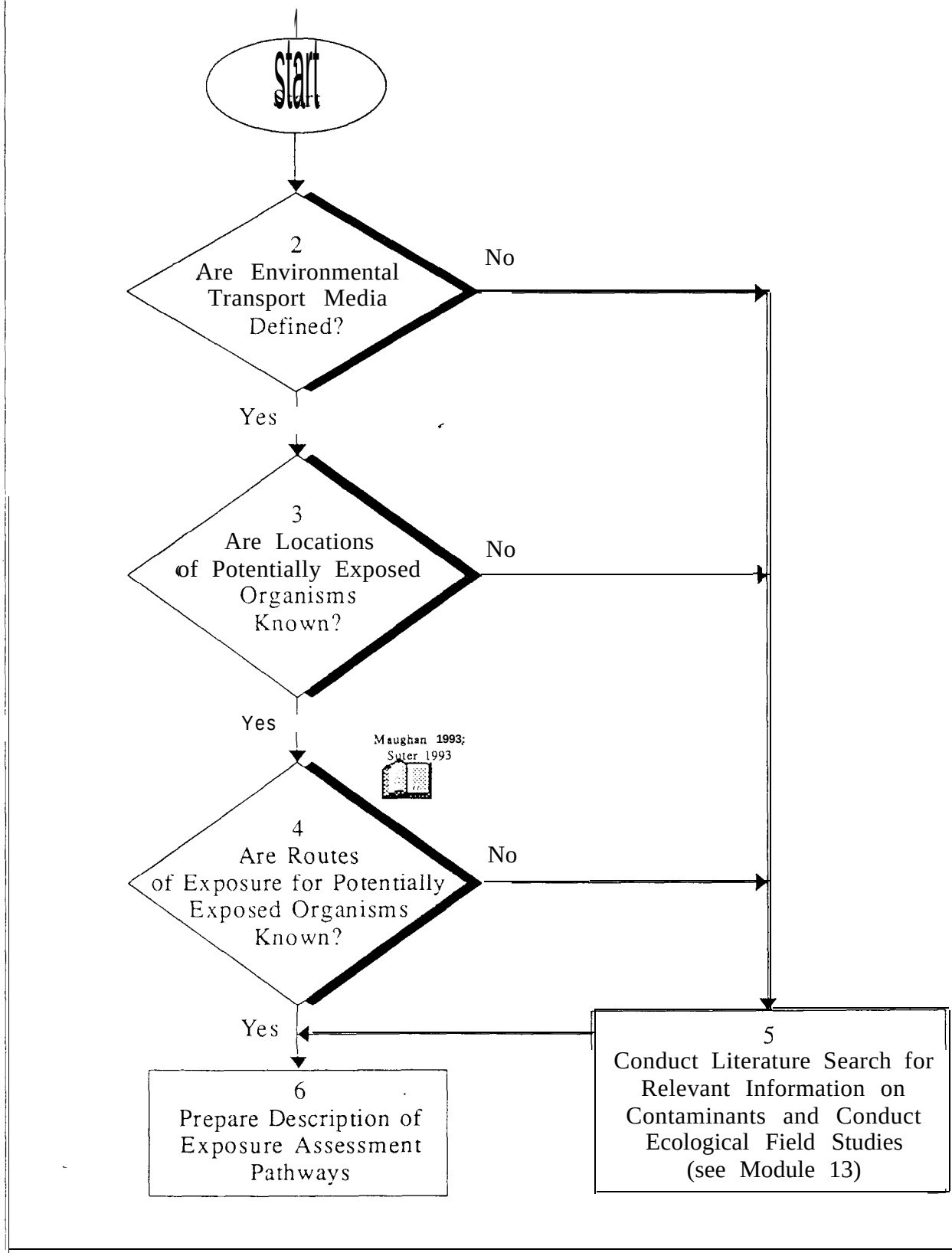
EPA, 1988a. ***Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final,*** report EPA/540/G-89/004, OSWER Directive 9335.3-01, U.S. Environmental Protection Agency, Washington, D.C.

MODULE 8:

POTENTIAL CONTAMINANT PATHWAYS IN ECOSYSTEM



Module 8: Potential Contaminant Pathways in Ecosystem



MODULE 8: POTENTIAL CONTAMINANT PATHWAYS IN ECOSYSTEM

Step 1 Start.

Step 2 Definition of the transport media may require determination of contaminant movement by air, surface water, and groundwater, especially when hazardous substances are deposited or released on the soil surface. The contaminant transport between media and biota and among trophic levels identified in the ecological conceptual model (see Module 6) should be determined to more accurately define both transport pathways and contaminant fate **(see Appendix A, Section *A.3.2).***

The work plan should specify the assessment of contaminant exposure, using fate and transport models. ***Fate*** concerns the ultimate chemical disposition of a contaminant (e.g., **remaining** stable, undergoing photodegradation, or combining with another substance). ***Transport*** **(or** migration) refers to the movement of a contaminant from one medium to another, from one location to another within the same medium, or into biota (EPA 1992b).

Step 3 Actual or potential exposure locations on- and off-site should be identified once the transport media are defined.

Step 4 Inhalation, ingestion, and dermal contact are exposure routes to be evaluated for contaminants at the CERCLA waste site. Suter (1993) provides examples of exposure routes and a discussion of toxicokinetic models to arrive at the internal doses to organisms exposed to a contaminant. Contaminant uptake can be predominantly from exposure along a single pathway or along multiple pathways. For example, in the latter situation, kit foxes at a semiarid oil field site can be exposed to contaminants by dermal exposure to drilling muds, soil ingestion, ingestion of contaminated prey, ingestion of drilling brines, and inhalation (Suter 1993). Multiple-route exposures to hazardous substances are shown in the diagram of the conceptual model (see Module 6). The most complex exposure routes occur in animals that utilize both terrestrial and aquatic habitats, particularly when soil, water. and sediments are all contaminated.

Step 5 A thorough literature review will assist the DOE ERPM in defining potential exposure pathways from the hazardous substance source to the target organism or population **(see Appendix A, Section k3.4).** Various databases have been developed on ecological effects of contaminants. The AQUIRE and PHYTOTOX databases developed by EPA cover effects to aquatic biota and terrestrial plants, respectively. Oak Ridge National Laboratory prepared an ecotoxicological database. The National Park Service has compiled a large contaminants encyclopedia database. Many publications within the past 10-15 years have reported biological effects from exposure to environmental contaminants. Although it is not the intent

of this document to review the literature on contaminant effects, the following guidance is provided as a starting point. While many scientific journals typically have included articles on environmental effects from exposure to contaminants, two notable examples are the *Bulletin of Environmental Contamination and Toxicology* and *Environmental Toxicology and Chemistry*. Also, project ecologists should become familiar with the contaminant hazard review series on wildlife prepared by the FWS. As of June 1992, 24 reports in the series had been published (see Module 10 for examples of recent reports). Also, Peterle (1991) provides a recent overview of environmental pollutants affecting wildlife. Newman and McIntosh (1991) describe conceptual bases for understanding the fate of various metals in the environment, with an emphasis on toxic ecological effects.

Step 6 Descriptions of potential exposure pathways will assist the DOE ERPM in further defining field sample collections and laboratory toxicity tests. The ecological work plan should include a description of the potential contaminant migration and exposure pathways within the ecosystems likely to be affected. This information should be incorporated into the conceptual site model. Suter (1993) addresses potential contaminant pathways within ecosystems, and Maughan (1993) suggests a process called "transfer pathway analysis" for determining species affected at waste sites. This process is iterative, consisting of increasing the level of detailed analyses as one proceeds with the analysis. Major steps in the transfer pathway analysis include (1) site inspection and reconnaissance, (2) species groupings by guilds, (3) identification of potential intake pathways, (4) selection of important receptor species, and (5) further refinement of contaminant transfer through intensive laboratory or field testing of a limited number of receptor species. Results are then incorporated into overall remediation alternatives evaluations.

References

EPA, 1992b. *ECO Update, Developing a Work Scope for Ecological Assessments.* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response,, Intermittent Bulletin 1(4):1-15., Washington, D.C.

Maughan, J.T., 1993. *Ecological Assessment of Hazardous Waste Sites.* Van Nostrand. Reinhold, New York.

Newman, M.C., and A.W. McIntosh (eds.), 1991. *Metal Ecotoxicology, Concepts and Applications.* Lewis Publishers, Inc., Chelsea, Mich.

Peterle, T.J., 1991. *Wildlife Toxicology.* Van Nostrand Reinhold, New York.

Suter, G.W., II, 1993. *Ecological Risk Assessment.* Lewis Publishers, Chelsea, Mich.